The distribution of coliform bacteria in waste water

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Abstract

Biological activity of water can be apparently judged by the colonization of bacteria (microbes). In order to find out the extent of pollution and the relationship between inorganic matters and microbiota, a quantitative and qualitative analysis of bacteria in various types of sewage waters, namely sewage water by the residential colonies (group I), industrial waste water (group II), sewage treatment hub (group III), unorganized collected waste water (group IV) and old residential waste collection center (group V), of Bikaner city (Rajasthan, India) was carried out from February, 2010 to May, 2010. Water samples were taken from surface only owing to low depth and investigated for various abiotic factors (viz. transparency, pH, carbonate, bicarbonate, total alkalinity, total hardness, salinity, chloride, calcium, magnesium, sulphate, nitrate, silica, and inorganic phosphorous) and biotic factors (viz. number and diversity of bacteria). The domestic sewage water causes major water borne diseases basing upon Total Bacterial Count (TBC) and *coliform* Count (CC). The *coliform* count in the present study ranged from 2.5 to 5.12 MPN/mL. Comparison of microbial population in sewage water from all different Groups was done and the higher values of TBC and CC were recorded only in Sewage treatment hub (Group III).

Introduction

The abundance and distribution of microorganisms in aquatic ecosystems result from a complex of environmental factors and trophic interactions among a multitude of biotic components. Water is synonymous to life as it is essential commodity for living beings including animals and plants, without which neither life nor development is possible. Domestic sewage is the major source of pollution of surface water in India which contributes pathogens, the main source of water borne diseases along with depletion of oxygen in water bodies.^{1,2} Sewage along with agricultural runoff and industrial effluents also contributes

large amount of nutrients to surface water causing Eutrophication.² Water microbiology is concerned with the microorganisms that live in water, or they can be transported from one habitat to another by water can support the growth of many types of microorganisms.³ However, the presence of other disease causing microbes in water is unhealthy and even life threatening.^{4,5} Bacteria found in the intestinal tracts of humans and other warm blooded animals, such as *Escherichia coli*, *Salmonella*, *Shigella*, and *Vibrio* spp. can contaminate water if feces enter the water supply.^{4,6} Microbiological studies are of great importance both from the point of view of monitoring and maintaining a proper aquatic environment as well as optimum utilization of the available and added nutrient for fish production.⁵ The microbiological examination of water has significant importance in case of pollution studies.

The aquatic microorganism includes pathogenic bacteria which cause diseases such as typhoid, fever, dysentery, diarrhea and cholera etc. The presence of pathogens is indirectly detected by studying indicator organisms.² The most common indicator organisms are a group of microbes called *coliforms* the presence of which simply indicates that pathogens are expected to be present.⁷

The term *coliform* refers to a group of bacteria that reside in the intestines of many vertebrates. It includes species such *Escherichia*, *Citrobacter*, *Enterobacter* and *Klebsiella*.^{8,7}

Water quality monitoring facilitates evaluation of nature and extent of pollution and effectiveness of pollution control measures, water quality trends and prioritisation of pollution control efforts. So in order to find out the extent of pollution, a study was conducted to know the relationship between inorganic matter and distribution of genera and population of bacteria in various types of sewage waters.

Materials and Methods

The investigations of sewage of Bikaner city was carried out from February, 2010 to May, 2010 (4 month). The results are presented as average of four months (Table 1 and 2, Figure 1). The water samples were taken from the surface, as the depths were very low, during morning between 7.00 a.m. to 12.00 a.m., and were investigated for various abiotic and biotic factors. Among abiotic factor included essential physicochemical parameters viz. transparency, pH, carbonate, bicarbonate, total alkalinity, total hardness, salinity, chloride, calcium, magnesium, sulphate, nitrate, silica, and inorganic phosphorous. Biotic factors included number and diversity of bacteria.

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Standard methods^{9,7} were followed for the monitoring of physical and chemical parameters. Bacteriological examination was done using standard procedure suggested by manual of APHA.³

Result and Discussion

In the present study major gram negative and *Enterobacteriaceae* family bacteria occurred in sewage water including *Klebsiella* spp., *Enterobacter* spp., *E. coli*, *Pasteurella* spp., and *Proteus* spp. Other than *Enterobacteriaceae* family, *Salmonella* spp., *Naissaria* spp. and *NLF Unidentified Enterobacter*, Gram negative bacteria are present.

The present study is divided into five groups (Table 1) *Enterobacter* and *E. coli* are significantly present in all the groups. Either of it and *NLF Unidentified Enterobacter* are present in Group I, II and III.

As compared in all the Groups higher prevalence of Gram's negative bacteria, comparatively in lower number, as follows- Group V> Group IV> Group III> Group I > Group II. The higher prevalence of *Enterobacteriaceae* occurs in only Group V. *Klebsiella* spp. is only present in single Group (V).

In general, the domestic sewage water causes major water borne diseases depending upon Total Bacterial Count (TBC) and *Coliform* Count (CC). In the present study, the *coliform* count in the present study ranged 2.5 MPN/mL to 5.12 MPN/mL. We also compared microbial population in sewage water from all different

Groups and we observed that higher value of TBC and CC only in Group III and lowest in Group V. TBC and CC are almost similar to Group IV and V respectively. (Table 2 and Figure 1)

Biological activity of water apparently judged by the colonization of bacteria development.¹⁰ The sewage generally contains many pathogenic microorganisms including vegetables and animal creatures too, as indicator of organisms for the characterisation of water and also suggested various bacteria for the individual saprobic stages.^{2,11} In present study major gram negative and *Enterobacteriaceae* family bacteria occurred in sewage water including *enterobacter* spp., *Klebsiella* spp. *Enterobacter* spp., *E. coli*, *Pasteurella* spp. and *Proteus* spp. Other than *Enterobacteriaceae* family, *Naissieria* spp. and *NLF Unidentified Enterobacter*, Gram negative bacteria are present.

Higher bacterial population was obviously due to addition of more sewage and fecal matters through greater human activities.¹¹ The fluctuation in the number of bacteria in sewage may be attributed to the irregular influx of domestic and industrial effluent into sewage.¹²

In the present study the total bacterial count was reported to be ranging from 42.0 to 55×10^6 MPN/100 mL. Similarly in another study¹² observed *Coliform* 8.00 to 920×10^7 MPN/100 mL, *E. coli* 2.00 to 630×10^7 MPN/100 mL, fecal *streptococci* 9.00 to 7700×10^3 MPN/100 mL, *Leptothrix* sp. Nil to 42×10^5 MPN/100 mL and *Zoogloea* sp. nil to 22×10^5 no.s/100 mL in sewage water of Aligarh. *Coliform*, *E. coli* and fecal *streptococci* from 14 to 224.6×10^6 MPN/100 mL, 8.9 to 47×10^6 MPN/100 mL respectively in sewage of Ahmedabad.¹³

Among the pond waters of Aligarh Kalidah, (which receives the sewage) contained more *coliforms* 200 to 490×10^5 MPN/100 mL, *E. coli* 70 to 280×10^5 MPN/100 mL, Faecal *streptococci* 230 to 490×10^2 MPN/100 mL, *Leptothrix* sp. 253 to 630 nos/100 mL and *Zoogloea* sp. 112 to 280 nos/100 mL. The fluctuation in the number of bacteria in sewage may be attributed to the irregular influx of domestic and industrial effluents into sewage.¹²

In the present study, bacterial counts were high. The bacteria can survive and reproduce more successfully under warm conditions^{6,14,15} due to free sediment water interactions and less available dilution in summer.⁵ Fecal bacterial indicators are known to have longer survival when in association with sediment particles.^{12,14} The presences of species of bacteria related to waterborne diseases were moderate thereby indicating non-potable nature of the waters.⁵

Conclusions

Water is contaminated with human wastes which may carry disease germs and parasites. In urban areas they may use water in toilets to carry these wastes away. Animal wastes may also carry disease germs which can get into water and pollute it. These wastes not only carry diseases and other dangerous things, they also may be high in nitrogen nutrients. Too high a level of nutrients can make algae grow too fast in streams, lakes or lagoons, smothering other kinds of life and building up until they start to rot and kill the fish. If the nitrogen compounds get into drinking water,

they can be turned into nitrites which have been linked to cancer in humans. Higher value of TBC and CC was noticed only in Sewage treatment hub (Group III) indicating more polluted than other types of water. The presences of species of bacteria related to waterborne diseases were moderate thereby indicating non-potable nature of the water.

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Table 1. Occurrence of different species of bacteria from different sewage groups of Study area.

Bacteria	Group I	Group II	Group III	Group IV	Group V
<i>Enterobacter</i> spp.	+	+	+	+	+
<i>Klebsiella</i> spp.	+	-	-	+	+
<i>E. coli</i>	+	+	+	+	+
<i>Pasteurella</i> spp.	+	-	+	-	-
<i>Proteus</i> spp.	-	-	-	-	+
<i>Salmonella</i> spp.	+	+	+	-	-
<i>Neisseria</i> spp.	-	-	-	+	-
<i>NLF Unidentified Enterobacter</i>	+	-	+	+	+

Table 2. Microbial populations in the sewage water samples in different groups from Bikaner.

Groups/Area	Total bacterial Count (10 ⁶ / MPN/mL)	Coliform Count (10 ⁶ /MPN/mL)
Group I (sewage water from residential colonies)	47	3.40
Group II (Industrial waste water)	52	4.40
Group III (sewage treatment hub)	55	5.12
Group IV (unorganized collected waste water)	42	2.90
Group V (old residential waste collection center)	40	2.50

Figure 1. Microbial population in different water groups.

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